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COLOR CHARACTERISTICS OF A PARAMETRIC SERIES OF HEAT-ABSORBING TONED GLASSES

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The possibility of producing toned glasses of various tints that can be used as construction and decorative and architectural materials is shown.

Heat-absorbing toned glasses produced by thermal forming on a metal melt are widely used both in Russia and abroad as construction and decorative architectural materials.

Four varieties of glasses are usually produced: blue, green, gray, and bronze. Tinting is carried out by adding elements with a prescribed absorption spectrum, in particular, ferric oxide, cobalt oxide, and metallic selenium, to the glass melt.

The Saratov Institute of Glass JSC has developed a technology for mass production of heat-absorbing toned glass employing thermal molding on a metallic melt. The thickness of the glass ranges from 3 to 10 mm.

A wide color range (up to 50 color shades) of toned glasses was obtained whose color parameters cover the entire visible spectral range. The dominating wavelength varies from 480 to 590 nm (for a light source of type C), which covers the spectral range from sky-blue to pink. At the same time, the tone purity varies from 5 to 40%, which corresponds to a color variation from virtually white to a deep color.

The components normally used in the industry for glass clarification are selenium and cobalt oxide or compounds containing them: 0.0005 – 0.005% Se and about 0.005% CoO. With a further increase in the content of decolorizing elements, variation of their ratio, and variation of the ratio of oxides of iron(III) and (II), it is possible to vary the spectra of toned glasses in a wide wavelength range.

The optical and chromatic parameters of a series of toned glasses developed and manufactured on the production lines of the Saratov Institute of Glass were investigated. Measurement results for part of the parametric series of glasses are shown in Table 1.

The integral light transmission in the visible and infrared spectral ranges was measured using FO-1 and ShEL-72 photometers and was determined for a thickness of 5 mm. The measurement error was ± 0.5%. Light-transmission spectra in the range of 185 – 900 nm were measured on a Specord M40 spectrophotometer. The measurement error was ± 0.5%. The chromaticity coordinates (X, Y) in the MKO system were calculated employing a microcomputer installed in the spectrophotometer. The dominating wavelength and the color purity were determined for a light source of type C. The color tone designations correspond to the ISCC-NBS system [1].

It can be seen from Table 1 that the developed technology makes it possible to obtain heat-absorbing (transmission in the IR range less than 75%) toned glasses of various degrees of saturation in a wide spectral range. It is possible to obtain glasses with the dominant wavelength differing by 1 – 2 nm and the color purity differing by 1 – 2%. The inte-

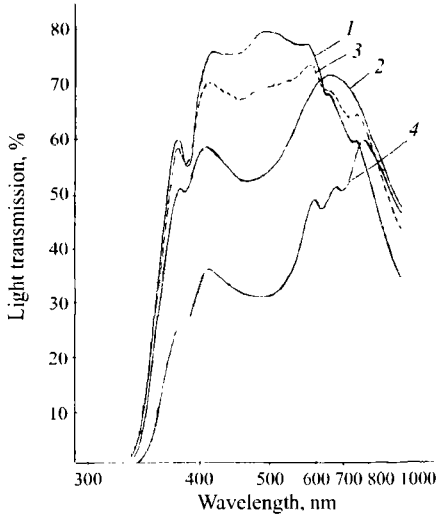

Fig. 1. Light transmission of toned heat-absorbing glass versus wavelength: *1*, *2*, *3*, and *4*) sky-blue, yellowish-brown, yellowish-green, and brown glass, respectively.

[1] Saratov Institute of Glass Joint-Stock Company, Saratov, Russia.

TABLE 1

Sample	Integral transmission, %, in spectral range		Chromaticity coordinates		Wavelength, nm	Color purity, %	Color tone
	visible	infrared	X	Y			
1	51.5	44.0	0.291	0.306	480	5	Sky-blue
2	71.3	38.4	0.298	0.318	490	5	The same
3	76.7	40.1	0.303	0.324	506	7	Bluish-green
4	76.4	38.4	0.304	0.321	510	5	The same
5	77.8	41.0	0.306	0.325	525	7	Greenish
6	70.1	45.1	0.308	0.324	530	8	The same
7	64.6	47.3	0.310	0.325	540	5	Yellowish-green
8	70.6	52.1	0.315	0.330	560	10	The same
9	68.7	53.6	0.317	0.327	570	10	Greenish-yellow
10	65.8	43.7	0.323	0.333	572	15	The same
11	66.4	38.7	0.335	0.345	577	22	Yellowish-brown
12	69.2	51.8	0.330	0.336	579	17	The same
13	68.5	52.5	0.337	0.339	580	20	"
14	51.3	49.7	0.340	0.337	581	20	Yellowish-orange
15	46.1	43.2	0.374	0.360	583	40	Brownish-orange
16	45.1	51.4	0.353	0.344	584	25	Brown
17	55.3	52.8	0.326	0.327	586	10	The same
18	55.3	55.0	0.330	0.329	586	15	"
19	63.4	58.2	0.332	0.327	590	15	Pink

gral light transmission varies from about 45 to about 78% in the visible range (calculated for a thickness of 5 mm) and from about 38 to about 58% in the IR range.

Typical transmission spectra of the glasses are shown in Fig. 1. The sky-blue shade is determined by the presence of iron oxide (absorption peak about 380 nm) and cobalt oxide, having absorption peaks in the green (530 – 540 nm) and red (600 – 700 nm) spectral ranges. The yellow and yellowish-brown shades are related to the introduction of iron oxide and metallic selenium, whose absorption band reduces the intensity of the blue range of the transmission spectrum (450 – 460 nm). A shift in the transmission band to the yellowish-green range occurs upon simultaneous introduction of iron and cobalt oxides and metallic selenium in certain proportions, which reduces the transmission in the blue and red spectral ranges. A further increase in the content of modifying additives results in an overall decrease in the light transmission and the appearance of a brown tint in the glasses.

Thus, the studies performed show broad possibilities for producing heat-absorbing toned glasses of various shades that can be used as building and decorative architectural materials.

REFERENCES

1. D. Judd and G. Vyshetski, *Color in Science and Engineering* [Russian translation], Mir, Moscow (1978).